TITLE: Gateway adapter for a PBX system

FIELD OF THE INVENTION

5   The invention relates to telecommunication devices, in particular to a gateway adapter that, when used in conjunction with a Private Branch Exchange (PBX) system, allows the combination of the two of them to interoperate with IP network based services – in particular, an IP

10 network based Call Server. The gateway adapter also extends to a method for front-ending a PBX such that their combination can exchange information with a packet switched network. In addition, the gateway adapter extends to an apparatus for offering IP network based telephony-related

15 services through to PBX based lines and trunks via a device emulation function.

BACKGROUND OF THE INVENTION

Circuit switching and packet switching are different and well-known methods for establishing a connection

20 between two endpoints to permit the exchange of voice or data signals. In the dial-up telephone network, for example, a caller's line goes to a switching center or switch, where the actual connection is made to the called party. In the case of a circuit switch, a permanent

25 connection is set-up and maintained for the duration of the call. A packet switch does not establish a permanent connection, rather the information is assembled in packets that are transmitted rapidly over a channel dedicated to the connection only for the duration of the packet's

30 transmission.

Telephone systems based on IP packet switching offer many advantages over circuit switching systems. In

particular, packet switching telephone systems have a
distributed architecture and offer a wide variety of
features that are difficult or costly to implement in
circuit switched telephone systems and the separation of
5 telephony services from telephony access allows their
independent evolution. Moreover, adapting multiple PBXs to
a single network telephony server (and hence a single
distributed PBX) represents a significant consolidation
opportunity (of a multi node network into a large single
10 node network) and hence a simplification value-add.

Most PBX systems in existence today are circuit
switched devices. In order to offer the above advantages
to customers who own these existing PBXs, telephone
15 equipment manufacturers are developing and commercializing
packet switched telephone systems that are intended to
replace existing PBX devices, or they are evolving their
legacy TDM PBXs. This latter method may be preferred by
customers who are hesitant to replace their existing PBX
20 when it is not yet totally obsolete.

Accordingly, there is a need in the industry to
develop a novel approach to upgrade a PBX such that it can
benefit from this new packet switched telephony systems
25 paradigm.

SUMMARY OF THE INVENTION

Under a broad aspect the invention provides a gateway
adapter for connecting a PBX system entity to a packet
30 switched network entity. The gateway adapter includes a
PBX interface for connection to the PBX entity to
communicate with the PBX entity using a PBX protocol, and
a network interface for communicating with a packet

switched network entity. An interoperation functional unit is associated with both interfaces. The interoperation functional unit effects manipulations on data received by the interfaces from the two entities such
5   as to allow the two entities to interoperate.

Hence, the gateway adapter allows the PBX to interoperate with a packet switched network without requiring either displacement of or any significant
10 modification to the actual PBX itself. This is a much less expensive alternative to a complete replacement of the PBX system by a new packet switched telephone system.

Optionally, the gateway adapter contains line and
15 trunk emulation functionality, and is able to manage all of the adapter's functionality separately from the management system of the PBX, and separately from the management system of the IP network based services.

20 Under a specific non-limitative example of implementation, the PBX system is a circuit-switched device and includes a plurality of internal telephone line ports for connection to telephone terminals and a plurality of trunk ports that interface to the PSTN or
25 ISDN. The PBX system includes a main processing unit that combines call processing and switching functions.

Under this example, when the PBX system is front-ended with the gateway adapter, the trunk ports are
30 connected to the PBX interface of the gateway adapter such that media and signals are now directed to the PBX interface rather than the PSTN or ISDN.

As part of the upgrade, the PBX system is configured

to disable the call processing functions it normally provides and provide a passthrough service instead. Accordingly, when a user on the PBX attempts to initiate a call, either internal or external he or she automatically

5 gets access to one of the trunk ports connected to the adapter.

The gateway adapter relies on a remote network services unit residing on the packet switched network to

10 provide call processing services, thereby alleviating the PBX's own call processing services from its traditional responsibilities. In particular, the interoperation functional unit processes control signals in the PBX system to generate communication control data in the

15 proper protocol compatible with the remote network services unit and sends the communication control data in the packet switched network through the network interface. The gateway adapter then receives communication control data from the remote network services unit containing

20 instructions on how to handle the call.

Under an exemplary embodiment, the interoperation functional unit has two main components, namely a signal processing unit and a media processing unit. The signal

25 processing unit provides an overall controlling function and the media processing unit handles media conversions, such as conversions of audio data received or sent to the PBX system from one format to another.

30   The instructions that the gateway adapter receives from the remote network services unit on how to handle the call may include details on where in the packet switched network to send the media from the PBX system (speech information in one direction of the call session) and on

how to handle the media received from the packet switched
network (speech information in the other direction of the
call session) i.e. which PBX port to deliver the media to.

5   Optionally, the interoperation functional unit is
designed to implement a device emulator such that the
gateway adapter behaves as a device of a specific type
with which the remote network services unit has been
specifically designed to interact. This feature allows
10 using the gateway adapter with a variety of remote network
services units that have not been conceived originally to
work with the gateway adapter, as well as with a variety
of PBXs that were not conceived originally to work with
the devices assumed by the network services units.
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        Under another broad aspect, the invention provides an
apparatus for providing telephony-related services to a
plurality of telephone terminals of a first type, the
apparatus including a network interface for exchanging
20 signals with a remote network services unit through a
packet switched network, the apparatus implementing a
device emulator to make the apparatus behave toward the
remote network services unit as a telephone terminal of a
second type, where the telephone terminal of the first
25 type is different from the telephone terminal of the
second type.

BRIEF DESCRIPTION OF THE DRAWINGS
        A detailed description of examples of implementation
30 of the present invention is provided hereinbelow with
reference to the following drawings, in which:

Figure 1 is a block diagram of a prior art PBX system;

Figure 2 is a functional block diagram of the main processing unit of the PBX system shown in Figure 1;

Figure 3 is a block diagram of the PBX system shown in Figure 1, upgraded with a gateway adapter constructed in accordance with a non-limiting example of implementation of the present invention;

Figure 4a is a high-level block diagram of the gateway adapter shown in Figure 3;

Figure 4b is a block diagram of a control unit of the gateway adapter shown in Figure 4;

Figure 5 is a block diagram of the gateway adapter depicted in Figure 4 showing additional details;

Figure 6 is a functional block diagram of the control unit of the gateway adapter depicted in Figure 4;

Figure 7 is a flowchart illustrating the various events that take place during a call session attempt spanning the PBX domain and the packet switched network, where the call session cannot proceed due to a busy condition;

Figure 8 is a flowchart illustrating the various events that take place during a successful call origination session spanning the PBX domain and the packet switched network;

Figure 9 is a flowchart illustrating the various events that take place during a successful call session involving two telephone terminals residing in the same PBX domain;

Figure 10 is a block diagram similar to the block diagram shown in Figure 3, providing additional details on the packet switched network; and

Figure 11 is a block diagram of a computing apparatus on which a program element can be executed to implement the gateway adapter shown in Figure 3.

In the drawings, embodiments of the invention are illustrated by way of example. It is to be expressly understood that the description and drawings are only for purposes of illustration and as an aid to understanding, and are not intended to be a definition of the limits of the invention.

DETAILED DESCRIPTION

Figure 1 illustrates the block diagram of a PBX system 10 according to the prior art. The PBX system 10 is a centralized device that provides telephone services to a group of telephone terminals. In particular, the PBX system 10 includes a plurality of internal ports for connection to telephone terminals 18, 20, 22 and 24. Also the PBX system 10 includes a plurality of external trunk ports 26, 28, 32 and 34 that in a typical PBX application would connect to the telephone network, such as the Public Switched Telephone Network (PSTN) 12. The PBX system 10 also comprises a main processing unit 14 that provides an overall controlling function and call processing services.

The main processing unit 14 controls a Time Division Multiplexing (TDM) circuit switch 16 that can establish audio paths between internal and/or external ports to set-up call sessions.

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Figure 2 provides a functional block diagram of the main processing unit 14. In addition to the call processing functions 36, the main processing unit 14 maintains for each telephone terminal 18, 20, 22 and 24 a
10 telephone terminal profile 38 that establishes how certain features of the individual telephone terminals 18, 20, 22 and 24 will operate. This characteristic allows a certain level of customization of the individual telephone terminals 18, 20, 22 and 24 to suit the user's
15 preferences. For example, the telephone terminal profile 38 specifies the particular ring tone, ring intensity, audio level, language of the messages that may need to be displayed, among many other possibilities.

20 The PBX system 10 is a circuit switched device that is designed to connect to the PSTN 12 that is also circuit switched. This specification describes a gateway adapter that allows the PBX system 10 to interoperate with a packet switched network. An example of implementation of a
25 gateway adapter 40 according to the invention is shown in Figure 3. The gateway adapter 40 forms a point of interaction between different domains, namely the PBX domain 46 and a packet switched network 44.

30 The gateway adapter 40 upgrades the PBX system 10 such that the PBX system 10 can interoperate with the packet switched network 44. In particular, such an upgrade allows making use of a remote network services unit that resides on the packet switched network 44. An

example of a remote network services unit is an
applications server residing at a certain node of the
packet switched network 44. The applications server
connects with the gateway adapter 40 and the PBX system 10
5   in a client/server relationship and offers to the gateway
adapter 40 and the PBX system 10 a host of functions, such
as call processing functions, trunk access functions (a
gateway to the PSTN), etc. To take advantage of the
functions offered by the remote network services unit, the
10 PBX system 10 is configured to passthrough any call
processing that the PBX system 10 would normally provide.
This results in a PBX system 10 in which when a user goes
off-hook at one of the telephone terminals 18, 20, 22 and
24, the TDM switch 16 responds by auto-originating an
15 outgoing trunk call out an associated trunk port at one of
the trunk ports 26, 28, 32, and 34, and subsequently
setting a connection path from the telephone terminal to
one of the external trunk ports 26, 28, 32 and 34.
Conversely, when an incoming call arrives at one of the
20 trunk ports (26, 28, 32, or 34), it is treated as an
inbound Direct Inward Dialing (DID) call by the PBX and is
subsequently delivered by the PBX to the appropriate
telephone terminal 18, 20, 22, or 24.

25   A functional block diagram of the gateway adapter 40
is illustrated in Figure 4a. The gateway adapter 40
includes a PBX interface 52 that connects to the PBX
system 10. The PBX interface 52 is the agency that forms
a point of interaction between the gateway adapter 40 and
30 the PBX system 10 and through which transit media (such as
audio information) signals and control signals. In
particular, the PBX interface 52 connects to the external
telephone line ports 26, 28, 32 and 34. The PBX interface
52 receives from and sends to the external telephone line

ports 26, 28, 32 and 34 media and control signals.

Figure 4a also shows a network services unit 43 communicating with the packet switched network 44.

Figure 4b is a block diagram of the PBX interface 52. The PBX interface 52 includes three main components namely a media signals channel 53, a control data translator 55, and a media/control signal splitter/combiner 57. The media signals channel 53 connects with the media extracted (by the splitter/combiner 57) from external telephone line ports 26, 28, 32 and 34 and effects media signals passing. In particular, the media signals channel 53 transports media signals exchanged between components of the gateway adapter 40 and any one of the external telephone line ports 26, 28, 32 and 34. The control data translator 55 effects a protocol conversion. In the case of control data sent from the PBX system 10 to the gateway adapter, the control data translator 55 will convert the form of the data into a format that the gateway adapter 40 and the remote network services unit 43 can use. Similarly, for control data sent form the gateway adapter 40 to the PBX system 10 the control data translator 55 effects the opposite conversion. In a possible variant, the PBX interface 52 can be provided with several control data translators allowing the gateway adapter 40 to function with PBX systems using different control data protocols. This feature renders the gateway adapter 40 more flexible in that it can adapt to a range of different PBX systems.

Referring back to Figure 4a, the gateway adapter 40 also includes a packet switched network interface 48 that forms a point of interaction between the gateway adapter 40 and the packet switched network 44. In a specific

example of implementation of this invention, the gateway
adapter 40 is designed to interact with a packet switched
network 44 that uses the IP protocol. The packet switched
network interface 48 effects mainly the necessary data
5 format conversion to allow media signals and communication
control data to be exchanged between the gateway adapter
40 and the packet switched network 44 and the remote
network services unit 43.

10   The gateway adapter 40 is also provided with an
interoperation functional unit 50 whose task, broadly
stated is to effect the necessary manipulations on data
(media and control) exchanged between the entities (PBX
system 10, packet switched network 44) such that the two
15 entities can functionally interoperate. A block diagram of
the interoperation functional unit 50 is provided at
Figure 5. The interoperation functional unit 50 has a
control unit 54 and a media signals converter unit 57 that
includes a plurality of media gateways 60 containing one
20 or more types of codecs.

     A functional block diagram of the control unit 54 is
illustrated in Figure 6. The control unit 54 includes one
or more device emulators 62 and a call session management
25 functional unit 63. The purpose of the device emulator 62
is to make the gateway adapter 40 behave during its
interaction with the remote network services unit 43 as a
device that has been specifically designed to interact
with the remote network services unit 43. It is to be
30 understood that the control unit 54 can implement a number
of different device emulators, each being adapted to
imitate a different device. At any given time one or more
device emulators can be active, but normally only one per
call session.

The device emulator 62 provides a bi-directional functional translation of control data exchanged between the PBX system 10 and the remote network services unit 43. A specific example will help illustrate this point. The remote network services unit may send to the gateway adapter 40 control data including display information in an attempt to display a message on a display screen of the device emulated by the gateway adapter 40. As per the previous example, assume that this device is a "stimulus" telephone terminal. The device emulator 62 intercepts this control data and analyzes it to determine if the actual telephone terminals 18, 20, 22 and 24 can handle it. If the control data can be handled unmodified by the telephone terminal 18, 20, 22 and 24 then the device emulator 62 passes the control data unchanged. Otherwise, the device emulator 62 will perform the necessary modifications such as to put the control data in a form that the telephone terminal 18, 20, 22 and 24 can use. For example, assume that the telephone terminal 18, 20, 22 and 24 has no display. The device emulator 62 needs to modify the control data since in its current form it cannot be handled by the telephone terminal 18, 20, 22 and 24. How the control data will be handled is a matter of design choice. One possibility under this example is simply to flush the control data since the telephone terminal 18, 20, 22 and 24 has no display capabilities. Another possibility is to generate a certain ring tone at the telephone terminal 18, 20, 22 and 24. Under a different example, assume that the telephone terminal 18, 20, 22 and 24 has a display, however, the display is smaller than the display on the emulated device and cannot handle the information in the control data. Under those circumstances, the device emulator 62 can re-format the

data to be displayed so that it becomes compatible with the display of the telephone terminal 18, 20, 22 and 24.

For control data sent from the telephone terminal 18, 20, 22 and 24 the same procedure as described above is followed. The control data is analyzed and modified if necessary such that it would appear to the remote network services unit 43 to originate from a device other than the terminal 18, 20, 22 and 24 and than the gateway adapter 40.

The bi-directional functional translation is made by mapping functional capabilities of the telephone terminal 18, 20, 22 and 24 to the functional capabilities of the device emulated by the device emulator 62. When the device emulator 62 is software implemented, the mapping of functional capabilities can be realized by creating a set of program modules, each program module handling the translation of a particular function or event. When a particular function or event is encountered by the device emulator 62, the corresponding program module is invoked and the functional translation made.

The call session management functional unit 63 controls the operation of the gateway adapter 40 when a call session must be set-up involving the PBX system 10. The call session management functional unit 63 can create several instances of a call session profile 64, each call session profile 64 being associated to a call session. A call session profile 64 holds information that allows the gateway adapter 40 to properly manage the media signals coming from the PBX system 10, the media signals directed at the PBX system 10 coming from the packet switched network 44 and also manage control signals exchanged with

the PBX system 10 and communication control data exchanged with the remote network services unit.

5 The operation of the gateway adapter 40 will be better understood from the following examples.

Call session between the PBX domain 46 and the packet switched network 44

The various events that occur during such a call session are illustrated by the flowchart of Figure 7. This flowchart should be considered in conjunction with 10 the block diagram of Figure 6 and the flowchart of Figure 10.

The process starts at step 100. At step 102 the user goes off-hook at say the telephone terminal 18. This event 15 is detected by the main processing unit 14 of the PBX system 10 and relayed to the gateway adapter 40 over the control data path via one of the interfaces 26, 28, 32, or 34. All digits dialed by the user at the telephone terminal 18 are collected by the main processing unit 14. 20 After collecting the digits, the main processing unit 14 prefixs them with a '9' digit, and effectively make an outgoing trunk call and signals the dialed digits (minus the '9') onto the control unit 54. At step 104, the control unit 54 assembles the digits (and other control 25 information) into a data packet and sends this data packet through the packet network interface 48 to the network services unit 43 residing in the packet switched network 44. In this example, the network services unit 43 provides call-processing functions and it is designed to 30 interact with telephone terminals that are different from the telephone terminal 18. For example, the network services unit 43 can be designed to interact with a so-called "stimulus" based telephone terminals. Those type of

terminals are known in the art and there is no need to describe them here. Before sending the communication control data, the control unit 54 invokes the device emulator 62 to perform the necessary functional translations as described earlier such that the network services unit 43 "thinks" that it is receiving this data from a "stimulus" based telephone terminal.

At step 106 the remote network services unit 43 receives the data packet, extracts the dialed digits and determines that the user at the telephone terminal 18 is attempting to set up a call that terminates outside the PBX domain 46.

At step 108 the remote network services unit 43 is "aware" of the status of the telephone terminal that the user at the telephone terminal 18 is attempting to call. Assume this party is a "stimulus" based telephone terminal 408 connected to a node 404 of the packet switched network 44. The remote network services unit 43 determines that the party 408 is busy. At step 110, the remote network services unit 43 will send to the gateway adapter 40 communication control data to indicate that the call cannot be completed for the time being. At step 112, the gateway adapter 40 receives this communication control data and invokes the device emulator 62 to respond to the network services unit in the same manner and form as a "stimulus" based telephone terminal would. In this example, the response is an acknowledgement to the message.

The communication control data received by the gateway adapter 40 cannot be sent to the PBX system 10 directly because the telephone terminal 18 is not designed

to handle this data. For instance, the "stimulus" based
telephone terminals designed to interact with the network
services unit 43 have a text display that shows the
message "busy" when the line of the called party is busy.
5 In contrast, the telephone terminal 18 has no display and
relies on a special tone to indicate to the user that the
line of the called party is busy. At step 114, the device
emulator 62 will perform a functional translation,
generating a control signal that is passed to the PBX
10 interface 52 where it is translated according to the
protocol used by the PBX system 10 to indicate by a
certain tone that the line is busy. At step 116, the main
processing unit 14 receives the signal and consults the
telephone terminal profile 38 associated with the
15 telephone terminal 18. The telephone terminal profile 38
states that when a busy line condition is encountered, a
busy tone should be generated on the line at a volume
level of 5 on a scale of 1 to 10, where 1 corresponds to a
low intensity tone and 10 corresponds to a high intensity
20 tone. The volume level of the tone is programmable at
each telephone terminal 18, 20, 22 and 24 to suit the
preferences of the individual users. At step 118, the
busy tone at volume level 5 is applied to the telephone
terminal 18.
25

    The process ends at step 120.

    Now assume that the call can be completed. The
flowchart that illustrates the events taking place in this
30 case is shown in Figure 8. The steps 200, 202, 204 and
206 are identical to the steps 100, 102, 104 and 106 and
will not be described again.

    At step 208 the network services unit 43 is "aware"

that the called party at telephone terminal 408 is
available and sends to the gateway adapter 40 a
communication control data indicating how to handle the
media signals, in particular, the IP address where the
5 media signals are to be sent (the address could designate
the called party or any other intermediate unit or entity
through which the media signals need to pass), the
particular type of encoding algorithm to use and
transaction control information, among others.

10

At step 210 the gateway adapter 40 receives the
communication control data and invokes the call session
management functional unit 63 that creates a call session
profile 64 for this particular call. The call session
15 profile 64 contains all the information that is needed by
the gateway adapter 40 to manage the call session. As part
of the creation of the call session profile 64, a media
path through the gateway adapter 40 is set. This is done
by assigning (step 212) a media gateway 60 to this
20 particular call. The function of the media gateway 60 is
to receive from the external telephone line port 26, 28,
32 and 34 media signals and convert those signals in a
form that is suitable for transmission through the packet
switched network 44. In a specific example, the media
25 signal at the external trunk port 26, 28, 32 and 34 is
analog. The analog stream is encoded by the media gateway
by using the speech-encoding algorithm specified by the
remote network services unit 43. This media path is
maintained for the entire duration of the call.

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At step 214, the encoded audio data is assembled into
data packets and sent out through the packet switched
network interface 48 to the address specified by the
network services unit and maintained in the call session

profile 64.   Typically, this address would be the address
at which the called party resides, namely the address of
the telephone terminal 408.

5   At step 216 the gateway adapter 40 receives media
signals from the telephone terminal 408 directed at the
telephone terminal 18.   The media signals are contained in
data packets. The control unit 54 consults the call
session profile 64 to determine how to handle the media
10   signals.   At step 218 the control unit 54 directs the
media signals through the media gateway 60 assigned to the
call.   At step 220 the media gateway 60 will decode the
audio information into an analog stream that is then
passed through the PBX interface 52 and applied at the
15   external telephone line port 26, 28, 32 or 34 assigned to
the call.

        The process ends at step 222.

20   The scenario in the case of a call terminating at the
PBX 10 and originating from the packet switched network 44
is largely the reverse of what Figure 8 shows with the
exception that when the incoming call arrives at one of
the trunk ports (26, 28, 32, or 34), it is treated as an
25   inbound Direct Inward Dialing (DID) call by the PBX 10 and
is subsequently delivered by the PBX 10 to the appropriate
telephone terminal 18, 20, 22, or 24.

        With reference to Figure 6, the control unit 54 has
30   the ability to set-up simultaneously a plurality of call
session profiles 64, where each call session profile 64
may be a call session profile as described earlier or a
call session profile during which the user transfers data,
such as streamed audio to the telephone terminal 18.

Assume for the sake of this example that all the call
session profiles 64 shown in Figure 6 involve the transfer
of streamed audio from different sources, such as a
weather report, traffic report, news service and music.
All those audio streams are received simultaneously by the
gateway adapter 40 that implements a selection mechanism
to determine which ones of the audio streams will be
directed to the media gateway 60 and ultimately directed
to the telephone terminal 18. The control unit 54
responds to a control signal generated from the PBX system
10 to switch from one audio stream to another audio
stream. Such control signal may be any kind of signal
that is recognizable by the gateway adapter 40. For
example, when the user at the telephone terminal enters a
sequence of DTMF tones, the resulting control data
generated within the PBX system 10 is conveyed to the
gateway adapter 40 that switches audio streams. By
successively entering various sets of tones, the user can
switch through the entire set of audio streams.

Call session between two telephone terminals of the PBX system

This case will be described in connection with the
flowchart of Figure 9 and the block diagram of Figure 10.
The steps 300, 302, 304 and 306 are identical to the steps
100, 102, 104 and 106 and will not be described again.
When the remote network services unit 43 receives the
dialed digits it determines that the user is attempting to
set up a call session between two telephone terminals
connected to the same gateway adapter. Assume for the
sake of this example that the user at the telephone
terminal 18 is attempting to set up a call session with a
user at the telephone terminal 20.

At step 308, the remote network services unit 43 determines if the call can proceed because it knows the state of both terminals, and more specifically in this case, the state of terminal 20.   The remote network services unit 43 sends to the gateway adapter 40 one or more data packets containing communication control data to initiate a call session with the telephone terminal 20.

After the gateway adapter 40 initiates the appropriate request to the PBX 10 to alert terminal 20 and after terminal 20 answers, and the answer is relayed back through to the remote network services unit, then at step 310 the remote network services unit 43 sends to the gateway adapter 40 communication control data on how to handle the media signals.   Two sets of instructions are sent.   The first set is associated to the media signals sent from the telephone terminal 18 while the second set is associated to the media signals sent from the telephone terminal 20. In response to the first set of instructions the call session management functional unit 63 creates a first call session profile 64. In response to the second set of instructions the call session management functional unit 63 creates a second call session profile 64. It will be appreciated that under this example, a call from one telephone terminal to another telephone terminal, where both terminals reside in the same PBX domain 46 is treated the same way as two separate calls spanning the PBX domain 46 and the packet switched network 44. The PBX 10 does not utilize its internal circuit switch to connect the two terminals, but rather the two terminals are connected together external to the PBX 10 via the packet network.

More specifically, under each call session profile 64 a media gateway 60 is assigned to each media signal

direction of the call session (step 316). The media
signals originating from the telephone terminal 18 pass
through one media gateway 60 for encoding. Next the
encoded media signals are sent to the packet switched
5 network 44 with the address of the called party (that
resides at the gateway adapter 40). The packet switched
network 44 returns back the data packets and they are
passed to another media gateway 60 for decoding and
ultimately transfer to the telephone terminal 20. Also
10 note that media signals transferred from the gateway
adapter 40 to the PBX system 10 use two separate external
telephone line ports 26, 28, 32 and 34, one for each
telephone terminals 18, 20 involved in the call session.

15 The process ends at step 318.

The gateway adapter 40 can be implemented in software
executed on any suitable computing apparatus. An example
of such computing apparatus is shown in Figure 11. The
20 computing apparatus includes a Central Processing Unit
(CPU) 500 that is coupled to a memory 502 over a data bus
504. The memory 502 holds the individual program elements
that implement the various functional units of the gateway
adapter 40 and also data on which the program elements
25 operate. The computing apparatus communicates with the
external world through an Input/Output (I/O) hardware
interface 506 that connects with the data bus 504.
Alternatively, components of the gateway adapter 40 can be
realized in hardware instead of software. A specific
30 example is the media gateways 60 that can be constructed
from one or more digital signal processors of a type known
to those skilled in the art.

Although various embodiments have been illustrated, this was for the purpose of describing, but not limiting, the invention. Various modifications will become apparent to those skilled in the art and are within the scope of this invention, which is defined more particularly by the attached claims.